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Adoption and Impact of Mobile-Integrated Business Processes – Comparison of Existing Frameworks and Analysis of their Generalization Potential

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Abstract

The integration of mobile workplaces in the (electronically mapped) intra-enterprise value chain is a major and still increasing corporate IT issue. Although the usage of mobile technologies for this purpose is far behind expectations and numerous failures can be observed, still little work has been done on theory building in this area.

In this contribution we identify and compare existing frameworks for adoption and impact of mobile technology to support mobile business processes. The hypotheses underlying these frameworks are challenged with experiences from three long-term case studies which are diverse in industry, company size and other factors in order to scrutinize their potential for generalization. The outcome is a set of hypotheses that show robustness against variation of major parameters and thus may be suitable to serve as a basis for a generalized and unified framework on mobile-integrated business processes.

1 Introduction

Usage and relevance of information technology (IT) in enterprises have changed fundamentally in recent decades. Instead of isolated IT usage limited to an operational level (e.g. production planning or machine-tool steering), vast electronification and networking in many enterprises have led to a strategic and area-wide IT usage through the electronic mapping of the intra-enterprise value chain [TuPo04]. In larger companies this was typically achieved through

the introduction of complex ERP systems while in smaller companies rather through the use of smaller industry-specific software packages. Resulting potentials include for instance common data management, integrated workflow management or contemporary availability of aggregated, edited corporate data (business intelligence). However, a major problem occurs as soon as single business processes (or even only parts of these) are executed mobile and thus can no longer be fully supported by the use of stationary IT. As a result, the integration of mobile workplaces is a major and still increasing corporate IT issue. While mobile information and communication technologies are available to fill in the gap, their actual usage for this purpose is far behind expectations. What is more, among the actually activated projects numerous failures can be observed (e.g. [Cogn05; Aber04]). Despite the high relevance of the topic theory building is not advanced at all. Our extensive research in high-ranked relevant literature¹ showed only little results (see section 2). Two frameworks were proposed: (a) [WaCh04] is deductively suggesting an *adoption framework* and examining it with an industry-specific survey (for a detailed description see section 2.1) and (b) [GeSh04] is deductively suggesting an *impact assessment framework* and examining it with one specific case study (for a detailed description see section 2.2).

The research objective of this paper is to investigate these two frameworks and scrutinize their potential for generalization. In order to do this, the underlying hypotheses are one by one challenged with the experiences from three in-depth case studies on mobile-integrated business processes which are diverse in industry, company size and other factors. The outcome is a set of hypotheses that show robustness against variation of major parameters and thus may be suitable to serve as a basis for a generalized and unified framework on mobile-integrated business processes. In the context of this paper, the term *mobile business processes* (MBP) refers to any business process which is (partly or completely) executed mobile and thus can not be fully supported by the use of stationary IT [GuPo05]. The term *mobile-integrated business processes* (MIBP) refers to any MBP that is fully supported by mobile IT [PoTh05].

The contribution is organized as follows: In section 2 the *adoption framework* from [WaCh04] and the *impact assessment framework* from [GeSh04] are introduced. In section 3.1 the

¹ Literature research comprised the following resources: MIS Quarterly (MISQ), Journal of the AIS (JAIS), International Journal of Electronic Commerce (IJEC), Communications of the ACM (CACM), Information Systems and e-Business Management (ISeB), International Journal of Mobile Communication (IJMC), Wirtschaftsinformatik (WI), Zeitschrift für Betriebswirtschaft (ZfB), Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung (zfbf), Schmalenbach Business Review (sbr), Die Betriebswirtschaft (DBW), and the proceedings of "Internationale Tagung Wirtschaftsinformatik".

method and the used case studies are explained. In section 3.2, the two frameworks are compared and in sections 3.3 and 3.4 the respective hypotheses of the two frameworks are examined. In section 4 the conclusion is drawn.

2 Existing Research

2.1 The Adoption Framework

The adoption framework of [WaCh04] is derived from previous research in the field of strategic choice theory and upper-echelon theory. Upper-echelon theory emphasizes the role of the firm's management in actively shaping organizational strategies [Chil72]. These research lines provide a theoretical foundation for understanding organizational decisions about innovation adoption. [WaCh04] identified critical factors that influence e- and mobile (m) business adoption by travel agencies and suggested a three level framework that states that differences between the technology adoption behaviours of firms can be fully captured only if the influential factors at multiple levels (environmental, organizational, and managerial) are taken into consideration [ToKl82; Roge95]. Moreover a firm's strategic orientation and the personal characteristics of its top managers influence its approach to innovation adoption. The framework was tested according to 7 hypotheses in a case study. In the study 137 completed questionnaires of the Taipei Association of Travel Agents were returned. Additionally a second study was depicted in this paper where they investigated to what extent the idea of mobile e-business is understood and accepted by travel agency CEO in Taiwan.

The findings show that no firm had a clear plan for mobile e-business. However, the CEO did point out that mobile advertising through the Short Messaging Service (SMS) would be the first mobile application despite the technological limitations of currently available mobile devices. Although the CEO agreed that the expansion to mobile e-business is only "a matter of time," [WaCh04, p. 56].

The suggested framework of [WaCh04] consists of the following elements:

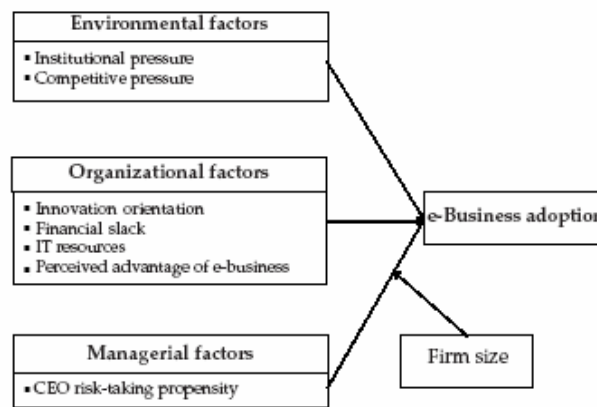


Fig. 1 Framework of e- and m-Business Adoption for Service Firms

The analysis of the data has been executed via hypothesis testing with statistical methods e.g. R-square and mean centering method proposed by Cronbach. Seven independent and two dependent variables (DV) have been defined: DV1 measures the firm's intention to develop e- and m-business applications and DV2 measures the degree of e- and m-business implementation.

2.2 The Impact-Assessment Framework

The impact-assessment framework of [GeSh04] is derived from the task/technology fit model [GoTh95] and the technology acceptance model [Davi89]. Moreover research on technology innovation [ToKl82] has been used by [GeSh04] to point out the importance of matching information systems with the organizational tasks to be supported or automated, as a precursor to system use and subsequent benefits. Recent research of Goodhue and Thompson's work has been extended and integrated with the technology acceptance model [DiSt98; DiSt99; MaKe98]. Other researchers have applied Zigurs and Buckland's framework to gain further insights on the success factors of group work [HoMO93]. The research framework combines the idea of task/technology fit with the general notion of impacts of information technology on organizations. The framework consists of four factors: technology, task, usage and impact to which a mobile business application is investigated. The parameters of each factor are depicted in **Fig. 2**. [GeSh04] validated the framework according to 9 propositions in a case study on a mobile e-procurement platform at a Fortune 100 company. The authors interacted with members of the project management group on a regular basis during the period from August 2001 to March 2002 to obtain information about the project, including objectives, progress, and organizational and technical details. Responses were collected from a total of 17 end-users and

used WAP-enabled cell phones. The study was conducted in Asia, USA and Europe. The suggested framework of [GeSh04] consists of the following elements:

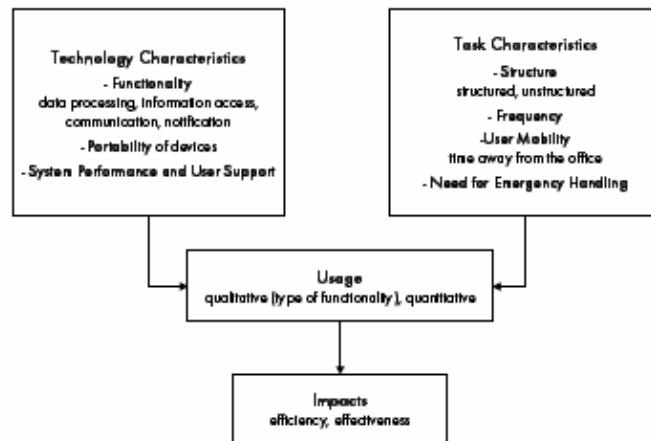


Fig. 2 The Impact-Assessment Framework [GeSh04]

The analysis of the data has been executed mainly via qualitative results from the interviews and quantitative measures like the amount of mobile tool usage for specific tasks. Moreover [GeSh04] analysed the correlations of the variables of their propositions.

2.3 Other Related Work

More recent research shows that mobile technologies and research in mobile applications are of increasing importance in various fields of applications e.g. [ScPL06; FoGK05]. [ChNa04] investigated the value of mobile business applications in domains like fast food restaurants, facility management, maintenance and housekeeping, insurance companies, support of sales force, logistics, mobile-marketing campaigns, real time weather information for the army and even the application of mobile technology for the efficient handling of formula one races. Obviously there are differences in the judgment about the impact of mobile-business applications in different branches. Whereas [WaCh04] found out that there was no need for mobile applications in 2004 for Taiwanese travel agencies [ChNa04] found out that mobile applications are widely applied in various branches. The amount of increasing research [ScPL06; WaCh04; ChNa04; GeSh04] and the improved mobile technology (device, connectivity, performance) indicate that mobile business applications are gaining importance. Therefore we want to verify in this paper if the hypothesis and the framework suggested by [WaCh04] are applicable to mobile business applications.

3 Comparison and Validation of existing frameworks

3.1 Method

Our research approach is based upon theory building from case studies [Eise89]. This approach is especially appropriate for obtaining complex details and novel understandings about a specific phenomenon under investigation. Case study research is appropriate for examining practice-based problems, since it allows a researcher to capture the knowledge of practitioners and use it to generate theory [BeGM87; Cres03; Eise89].

The overall aim of our research is to contribute to theory building in the area of MIBP. We consider case study research as a suitable approach for the investigation of MIBP impact and adoption factors as it provides the opportunity for longitudinal research and in-depth investigation especially of socio-technical interdependencies. Both [WaCh04] and [GeSh04] suggest further research should test the framework applicability in different industry domains and different organizations. Thus, we selected case studies to be most diverse in order to validate the limits of the frameworks. As a comparison of the case studies themselves is not intended negative effects of this diversity do not occur. As a common characteristic, the examined MBP in all three case studies is technical customer service provision. Most important differences are industry and organization size. All three case studies have been longitudinal studies and lasted from 6 to 15 months. Within the studies, methods like expert and user interviews as well as questionnaires have been applied to collect data. Interviews have been transcribed and fed back to the interviewees in order to reduce possible errors. For data gathering CEO, CTO, project managers and end users of the mobile application have been questioned with semi-structured questionnaires in personal or via-phone interviews. In the large company four persons have been interviewed, in the medium-sized company two and in the small one again four. Moreover, in the small IT service company we conducted an in-depth usability and tool acceptance study with 30 users [PoTh06]. Table 1 provides an overview of the examined case studies.

Case Study 1: Telecommunication Service Provider

For the first case study we investigated a mobile dispatching and order handling system of a major European Telecommunication Service Provider. 12,000 technicians have been equipped with standard commercial PDA. The introduction of MIBP was conducted in iterative steps from the year 2000 until now. Legacy systems have been substituted by mobile client-server architecture (although service order generation and handling are still conducted on separate information systems for private and business customers). Main tasks of the field technicians

include installation, maintenance and repair of telecommunication products. Service orders are dispatched automatically considering skill level, location, optimal routing, urgency and the respective Service Level Agreements (SLA). Order information is then transmitted via GPRS on the PDA. 50% of the orders are dispatched prior to the working day, the rest during the day.

Case Study 2: Municipal Utility Company

For the second case study we investigated a major German Municipal Utility Company and its mobile service, maintenance and invoicing process. About 1,000 technicians have been equipped with standard industry PDA. MIBP were introduced a one year project with the support of a specialized consulting company. Typical tasks of the utility technicians are e.g. installation and maintenance of meters for gas or electricity in private, public or industry buildings. Due to special restrictions and the need of managerial control, dispatching stayed manually: Technicians come to the office, receive their schedule and then head off to customers. During the day they are now able to receive new jobs, accept or deny them and send status reports.

Case Study 3: IT Service Provider

For the third case study we investigated an Austrian IT Service Provider for hard- and software installation and maintenance. 40 IT service technicians have been equipped with mobile devices. The system was implemented with an Application Service Provider (ASP), implementation took 6 month. Field technicians use a browser-based solution on the mobile device in order to receive their jobs for the day which can be rescheduled via an implemented push-mail function. Main tasks of an IT service technician include repair, maintenance and installation of different hard- and software. A major driver for MIBP introduction was to shorten issuing the invoice, for which especially the record of working/driving time and used spare parts is essential.

Company	Service	Business	Company Size	Architecture	Implementation process	Dispatching
Telecommunication Service Provider	Technical customer service	B2B and B2C	Large	Client/server system; separate IS B2B/B2C	Backend and client	Automatically
Municipal Utility Company	Technical customer service	B2B and B2C	Medium	Client/Server	Backend and Client	Manually
IT-Service Provider	Technical customer service	B2B	Small	ASP solution, browser-enabled client	Server	Manually

Tab. 1 Case Study Overview

3.2 Comparison

This section will provide a comparison of the two frameworks introduced in section 2. The following table opposites the most relevant characteristics:

E-Business Adoption Framework	Impact-Assessment Framework
Measures the adoption behaviour of new technologies according to the tree factors: environment, organization and managerial	Suggest Propositions which are tested according to validate the framework
Aims at identifying critical factors that influence e-business adoption in travel agencies	Aims at identifying factors that influence successful m-business application usage
Approach: Case Study Research	Approach: Case Study Research
Hypothesis testing	Qualitative Research which quantitative implications
Limitations	Limitations
Further empirical studies in other application domains should be executed to validate the generalizability of the framework	Further empirical studies in other application domains should be executed to validate the generalizability of the framework
No evolution of the framework has been done considering mobile applications	Respondents have been partially self selected

Tab. 2 Comparison of the e-business adoption- and impact-assessment framework

[WaCh04] applied quantitative validation of hypothesis with 137 completed questionnaires from different companies whereas [GeSh04] applied a more qualitative approach using interviews among 17 partially self-selected respondents within one case study.

3.3 Validation of the adoption framework

In this section we will first introduce the hypotheses and the findings of [WaCh04] and than state differences and common findings in comparison with the three case studies.

The 7 hypothesis of [WaCh04] are:

Hypothesis 1: Institutional pressure is positively related to a firm's adoption of e-business.

Institutional pressure can come from governmental bodies, trade associations, consulting companies, business media and other stakeholders. [WaCh04] found no significant relationship between institutional pressure and either intention to develop e-business or degree of e-business implementation. Consequently, H1 is not supported.

Case Study findings: In our three case studies we could not find any concrete evidence for institutional pressure. As the technical service market is not regulated by governmental bodies but under private company management institutional impacts play a minor role. However for practical implications we found some anecdotal evidence that increased institutional pressure would increase DV1 and DV2 especially if pressure comes from financial stakeholders.

Hypothesis 2: Competitive pressure is positively related to a firm's adoption of e-business.

Competitive pressure has a significant positive relationship with e-business implementation. It has only a marginally significant relationship ($p < 0.10$) with the intention to develop e-business. Arguably, H2 is supported.

Case Study findings: In our case studies DV1 and DV2 have been supported. Due to very short Service Level Agreement (SLA)-fulfilment times in the technical service branch in general efficient and effective process organisation for the dispatching of technicians, spare parts and invoicing are essential for longitudinal market viability. We could further investigate that over the period of investigation (in the longest case 15 months) more and more technical service companies adopted mobile technology and in the same time the amount of mobile solution providers increased. Mobile technology is a critical success factor for long-term market viability; especially for small companies technology leadership is vital.

This applies to all three case studies and company size did not have an influence on these findings.

Hypothesis 3: A firm with a high level of innovation orientation is more likely to adopt e-business than a firm with a low level of innovation orientation.

Innovation orientation is positively associated with intention (as proposed in H3), but not with degree of implementation. Consequently one can conclude that innovation orientation has little to do with a firm's "real" involvement in e-business.

Case Study findings: The case studies revealed that the DV1 can be supported and DV2 can only be supported partially in small and medium-sized (SME) companies. This is due to the fact that smaller companies often lack the resources for innovation (e.g. no specific R&D department) and the investment power is reduced. In large organizations we could investigate the same phenomena as [WaCh04]. Due to the relatively slow decision processes in large companies it is difficult to implement innovative approaches like e- and mobile business even though the intention to adopt e-business might be very high. Especially in large organizations the role of the management and the amount of management commitment and sometimes pressure to implement mobile and e-business technology plays an important role. If management commitment or pressure is given DV1 and DV2 can be supported.

Hypothesis 4: The perceived advantage of e-business is positively related to a firm's adoption of e-business.

This hypothesis is partially supported, a significant positive relationship was found between perceived advantage of e-business and intention to adopt e-business.

Case Study findings: In our case study we could observe that in the SME companies the degree of e-business implementation is higher than in large organizations. The small and medium sized companies implemented e- and mobile business applications once the intention to adopt e-business was given. In the large technical service providing company more hesitation to implement e- and mobile business applications could be observed.

Hypothesis 5: Financial slack is positively related to a firm's adoption of e-business.

In the present study DV1 was supported while DV2 was not. A significant positive relationship was found between perceived advantage of e-business and intention to adopt e-business. Financial slack is positively associated with the degree of e-business implementation. However, the proposed positive relationship between financial slack and intention to adopt e-business is not supported. Instead, there is a negative correlation between the two variables. The more financial slack, the more implementation can be done.

Case Study findings: In our case study mobile application projects have been tackled when sufficient financial resources have been available. Once the resources could be provided DV1 and DV 2 had a positive correlation and the intention to develop e- and mobile applications lead to higher degree of application implementation.

Hypothesis 6: IT resources have a positive effect on a firm's adoption of e-business.

The last organizational factor, IT resources, has positive relationships with both DVs and H6 is supported.

Case Study findings: This could also be observed in the case studies and is mainly due to the presence of IT knowledge and already (partially) existing infrastructures (e.g. Servers). Once IT knowledge about the implementation of an e- or mobile business application was present the reluctance towards mobile tool implementation decreased as the CEO and CTO have been more confident that the investment will pay off rather quickly.

Hypothesis 7: CEO risk-taking propensity has a positive effect on a firm's e-business adoption. The effect is moderated by firm size; it is stronger in smaller firms than in larger firms.

The firm size moderates the relationship between CEO risk-taking propensity and each DV. The relationship is positive when firm size is small and negative when firm size is large.

Case Study findings: These findings align with the results of our case studies. We identified that the more direct a CEO can decide upon an e- or mobile commerce strategy the more likely it was that those strategies have been adopted. Moreover for SME the competitive advantage gained through faster service processes is vital to keep up with competitors and large organizations.

3.4 Validation of the impact-assessment framework

In this section we will first introduce the propositions and the findings of [GeSh04] and then state differences and common findings in comparison with the three case studies.

The nine propositions of [GeSh04] are:

Proposition 1: Users will first use mobile business applications for notification and communication purposes rather than for data processing and information access.

For this proposition limited support could be found in the Case Study. The users showed willingness to use mobile devices (cell phones) for innovative purposes which means the users

applied the mobile device for tasks they never did before e.g. the notification about waiting approval requests.

Case Study findings: In the case studies we could support this findings and identified that typically mobile devices like mobile phones or PDA are first used for communication purposes and then for e.g. to access the company ERP systems or CRM systems, but this depends on the management directives within a company. If the managerial pressure is rather high and mobile tool usage is fostered strongly we observed that in SME a former paper-based process can be replaced through mobile tool usage in a short period of time. From a business process reengineering perspective this is a bomb-dropping strategy [HaCh93] and can cause employee reluctance as the process change might be too fast for stepwise adoption.

Proposition 2: There is a trade-off between portability and usability of mobile devices, effectively limiting the usage of mobile business applications to simple activities.

This proposition could be supported by the Case Study findings. While users acknowledged the portability of the device, its usability drew criticism. Over two-thirds of the respondents indicated that the small screens and limited keyboards were significant or very significant limiting factors. [GeSh04] investigated that the usability judgement depends highly on the used device. “While a number of users commented that screens and keyboards were too small, one of them experienced a different situation. This participant, who had access to a phone with a larger colour screen and full keyboard, was in fact positive about the usability of the application” [GeSh04 p. 30]. Users preferred to use the tool for simple tasks, such as notification and approval requests.

Case Study findings: The findings in the three case studies support proposition 2. Tool usability is an enabler for innovative applications and especially for mobile applications as they are used while the user is in a mobile condition (walking, standing, and driving). Therefore usability requirements are even more sophisticated than for standard desktop applications [PoTh06].

Proposition 3: System performance and user support have a positive impact on the usage of mobile business applications.

This proposition could be supported. System performance and user support had a positive impact on the usage of the mobile business application, but in the present case poor performance was found to have a negative impact on usage. Some user reported that the downloading time is longer on the mobile device than on the desktop-based application which made it hard to justify the effort.

Case Study findings: System performance factors are highly connected to usability perceptions of a system [PoTh06]. When new mobile applications are introduced to the end users in a prototype state, where performance is usually slower due to the test setting, tool reluctance can increase. Therefore it is important to state clearly that

the system is in a preliminary status and performance rates are not the same as in the real-life running system. In our case studies usability and performance have been identified as a major facilitator for mobile tool acceptance.

Proposition 4a: Employees performing highly structured tasks tend to use mobile business applications for data processing.

The approval tasks of the finance and accounting approvers were much more structured than the tasks of the approving managers. Compared to approving managers, finance and accounting approvers indicated a higher percentage of approvals that could be submitted via the mobile application, providing evidence for proposition 4a.

Case Study findings: In the application domain of technical service support proposition 4a holds as well. The tasks of service technicians are highly structured and therefore mobile tool support can easily be implemented. The typical task set of a service technician consist of order acceptance/denial, documenting the repair,- driving time as well as the used spare parts and transmit the data to the head office. In case of requests (e.g. further details to the order or unclear information) the technician calls the dispatcher or back office. Well structured tasks are easy to be executed via a mobile tool. As the modality functions are limited on a mobile device the workflow should be supported efficiently with a mobile tool.

Proposition 4b: Employees performing unstructured tasks tend to use mobile business applications to access information and for communication purposes.

In the study of [GeSh04] approving managers indicated a higher percentage of approvals where the mobile application could support communication and access to information this provides evidence for proposition 4b.

Case Study findings: The case study findings support this proposition as well. In our study sells representatives especially in the small company used the mobile applications to access current prices and information about the customer e.g. prior communication. The tasks of sells personnel are far less structured than the tasks of technical support stuff. The necessary information depends on the actual information and can hardly be planned in advance. Consequently the case study findings support the findings of [GeSh04] in proposition 4.

Proposition 5: The frequency with which a task is performed has a positive impact on the usage of mobile business applications.

In the study of [GeSh04] finance and accounting approvers generally indicated a higher number and dollar volume of approvals than managing approvers. This difference in volume reflected the fact that finance and accounting approvers basically performed approvals on a full-time basis, whereas managers had a broader set of responsibilities. In line with Proposition 5, one would expect finance and accounting approvers to be more optimistic about the mobile e-procurement application than approving managers. For the data set, however, the correlation between repetitiveness and possible usage was negative (-0.4), indicating that higher volume

approvers found the mobile application less useful than approvers who had lower levels of repetitiveness. Evidence gained from user comments indicated that a combination of frequency of task performance and mobility can have greater explanatory power of usage than each factor alone. However it is unclear if this proposition can be dismissed but it is likely that the judgment of the users has been influenced by factors like general enthusiasm for the new technology and difficulties in establishing system access.

Case Study findings: In our case studies we found clear evidence for proposition 5 in the SME companies in the large organisation tool usage was hindered in the beginning due to a high mobile tool reluctance of the technicians. In the large organization tool acceptance and workflow change needed far more time than in the SME. One might argue that this is only due to the size of an organization but we could also investigate that the degree of employee involvement in the design and implementation of a mobile application, especially the workflow design have highly positive influence of tool acceptance and the frequency of tool usage. Another factor that could be observed as relevant was that the system was fully implemented and not in a prototype state when the end user started to use it for operative tasks. Therefore performance and access issues to the system did not arise.

Proposition 6: Employees who are more mobile tend to use mobile business applications more often to perform their tasks than employees who are less mobile.

As mentioned above some of the 17 users stated that a combination of frequency and mobility can have greater explanatory power of usage than each factor alone. Unfortunately [GeSh04] do not indicate how many users made such statements. However there was a positive correlation (0.3) between mobility (time out of the office) and intended usage of the mobile e-procurement application for approval processes.

Case Study findings: In our case studies this could be verified and especially the CEO and CTO of all three case study companies used their PDA or mobile phones extensively when on business trips.

Proposition 7: The use of mobile business applications is positively related to the perceived need to handle emergency situations.

For this proposition a variation among users regarding the question of what constituted an emergency situation could be revealed. However only some anecdotal evidence could be found to support this proposition.

Case Study findings: In our case studies we could find clear evidence for this proposition in every company. The domain of service technicians is highly structured according to SLA priorities and sometimes urgent incident handling e.g. a virus attack. For efficient reaction and fast incident handling mobile tools offer the necessary flexibility to increase the SLA fulfilment rate and consequently increase customer satisfaction and the positive perception of the technology leading companies in the market.

Proposition 8: The use of mobile business applications increases employee productivity and operational efficiency.

This proposition could be supported but [GeSh04] suggest that future research should consider both direct effects on the user and indirect effects on employees interacting with the user.

Case Study findings: From a process management view we followed a holistic approach and investigated the whole process from the order generation to the invoice delivery to the customer [TuPo04]. Within this process the service technician is not integrated into the process chain while doing repair and maintenance jobs at the customer's site. Mobile technology provides the possibility that a service technician stays integrated in the business process e.g. company order generating system, ERP-Systems while being physically mobile for task execution. Consequently we could investigate that large gains in efficiency and effectiveness could be gained in the invoicing and dispatching processes. Invoicing used to be cumbersome as the necessary data (working-, driving time and amount of used spare parts) used to take one working week (5 days) to be transferred from the paper-based forms to the desktop application and to be available for further processing. Due to reduced redundant data entry the error prone process of work protocol transcription could be optimized e.g. about 10 min per day per technician in the small company. Additionally the dispatching (allocation of jobs to a specific service technician) was inefficient as the dispatcher had to make three calls on average to reach a free technician as the status e.g. repair progress and location was only traceable via phone calls. After the mobile tool integration dispatching could be done far more efficient in 85% of all calls via the mobile tool without phone calls and the whole invoicing cycle could be reduced from 10 days down to 4 working days on average.

Proposition 9: The use of mobile business applications improves organizational flexibility and the ability to handle emergency situations.

[GeSh04] found out that no clear understanding of the value of increased flexibility and the ability to handle emergency situations existed among the users. Some anecdotal evidence could be found that users appreciated the fact that the application allowed to keep in touch with co-workers while out of the office.

Case Study findings: The case studies revealed the same as for proposition 7 and proposition 9 can therefore be supported.

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Proposition	Evidence form case study
Proposition 1: use for notification and communication purposes	Limited
Proposition 2: trade-off between portability and usability	Yes
Proposition 3: impact of performance and user support on device usage	Yes (strong evidence)
Proposition 4a: highly structured task increase foster mobile tool usage for data processing	Yes
Proposition 4b: unstructured tasks foster mobile tool usage for information and communication purposes	Yes
Proposition 5: task frequency has an impact on mobile tool usage	Unclear
Proposition 6: mobile employees tend to use mobile tools more often	Yes
Proposition 7: mobile tool usage is positively related to the need of handling emergency situations	Sometimes (anecdotal evidence)
Proposition 8: mobile tool usage increases employee productivity and efficiency	Yes
Proposition 9: mobile tool usage increases organizational flexibility and the ability to handle emergency situations	Sometimes (anecdotal evidence)

Tab. 3 Summary of the findings for [GeSh04]

3.5 Suitability for generalization

In general, generalization potential for both frameworks is extremely good. Not only has to be stated that a vast majority of the hypotheses could be validated with the three diverse case studies, but even case study research revealed that some propositions (like e.g. [GeSh04] proposition 7 and 9) could be supported whereas the original study with its limited validation effort only showed anecdotal evidence.

Case Study research is less rigour than an experiment design with hypothesis testing and statistical analysis. However, correctly applied it is able to provide convincing evidence and valid implications with regard to practice, especially if long-term in-depth studies are possible. The detailed results of the validation are shown in Tab. 4.

Moreover the frameworks can be used in industry context for the analysis of business processes to evaluate their mobilization potential and therefore serve as decision support for management.

Frame- work/Findings [WaCh04]	Case Study Findings [WaCh04]	Framework/Findings [GeSh04]	Case Study Find- ings [GeSh04]
H1: no evidence	anecdotal evi- dence	P1: limited evidence	Support
H2: DV2	DV1 + DV2	P2: support	Support
H3: DV1	DV1	P3: strong evidence	Strong evidence
H4: DV1	DV1 + DV2	P4a: support	Support
H5: no evidence	DV1	P4b: support	Support
H6: DV1 + DV2	DV1 + DV2	P5: unclear	Clear evidence in SME; partially in large organization
H7: DV1 + DV2	DV1 + DV2	P6: support	Support
		P7: anecdotal evidence	Support
		P8: support	Support (strong evidence)
		P9: anecdotal evidence	Support

Tab. 4 Comparison of [WaCh04], [GeSh04] with the Case Study Findings

Beyond the validation of the hypotheses 1 to 7 and the propositions 1 to 9 the difficult and critical issues within the field of mobile technology are to measure the degree and speed of technology adoption within the mobile arena. Again in depth, long-term case study research can provide further insights and deeper understanding of the socio-technological interdependencies. Additional research in this area is necessary and we would like to encourage researchers in the field of mobile-integrated business processes to conduct further joint studies.

4 Conclusion

The research objective of this paper was to investigate the *adoption framework* from [WaCh04] and the *impact assessment framework* from [GeSh04] and scrutinize their potential for generalization. In order to do this, we challenged the underlying hypotheses one by one with the experiences from three in-depth case studies which are diverse in industry, company size and other factors.

The outcome is a set of hypotheses (shown in table 4) that shows robustness against variation of major parameters.

Above the level of single hypotheses, both frameworks showed an unexpected high potential for generalization in the area of technical customer support over diverse industries and company sizes. While on a tactical level, further validation outside of technical customer support is supposed, the next step is to form a generalized and unified framework on mobile-integrated business processes using the validated hypotheses and validate this with a large-scale empirical study in order to come to valid theories and help practitioners to be successful in this domain.

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